ZOOLOGY.—Buccella, *a new genus of the rotalid Foraminifera.* Harold V. Andersen, Louisiana State University. (Communicated by Alfred R. Loeblich, Jr.)

In 1948–1950, while working with foraminiferal faunules from the mudlumps off the Passes of the Mississippi River, the need for a new genus of Foraminifera became apparent. The species selected as the genotype, and also designated the genotype in this paper, has recently been described by Phleger and Parker (1951) as *Eponides hannai.* The morphologic feature of *E. hannai* that makes the species untenable as an *Eponides*—the presence of multiple apertures on the ventral side of the test—constitutes the diagnostic morphologic feature of the new genus *Buccella* introduced in this paper.

Also characteristic of *E. hannai* is a coating of pustules on the ventral side of the test. This morphologic feature was the medium by which the following species and varieties of *Eponides* in the U. S. National Museum and Cushman Collections were brought into the present study:

Eponides alabamensis Cushman and McGlamery, 1938
Eponides choctawensis Cushman and McGlamery, 1938
Eponides frigida (Cushman), 1921 (1922)
Eponides frigida (Cushman), var. *calida* Cushman and Cole, 1930
Eponides hannai Phleger and Parker, 1951
Eponides mansfieldi Cushman, 1930
Eponides mansfieldi Cushman, var. *oregonensis* Cushman, Stewart and Stewart, 1947 (1948)
Eponides peruviana (d'Orbigny), Cushman and Kellett, 1929; Cushman, Stewart and Stewart 1930; and Cushman and Parker, 1931
Eponides vicksburgensis Cushman and Ellisor, 1931

When the types of the above species were studied, discrepancies were noted between the descriptions and illustrations and the actual specimens, and within suites of specimens bearing the same specific designation. As a result of these discrepancies, three new species of the genus *Buccella* (*depressa, inusitata,* and *parkerae*) are described, and five species of Eponides (*hannai, frigida, mansfieldi, mansfieldi* var. *oregonensis,* and *vicksburgensis*) are placed in the genus *Buccella.* Emended descriptions and new figures of the above species of "*Eponides,*" with the exception of "*E.*" *mansfieldi* var. *oregonensis,* are presented to record the morphologic features omitted in the original descriptions that justify the assignment of these species to the genus *Buccella.*

Also as a result of this study, "*Eponides*" *frigida* (Cushman) is eliminated as a typical species of *Eponides* as suggested by Hofker (1950).

Acknowledgments.—The preparation of this paper was facilitated by the following people whose assistance and contributions are gratefully acknowledged: Dr. G. Arthur Cooper and Dr. Alfred R. Loeblich, Jr., U. S. National Museum, who placed the National Museum samples and equipment at the writer's disposal and aided in the preparation of this report; Miss Ruth Todd, U. S. Geological Survey, who reviewed the manuscript and supplied the samples from which the new species were described; Mrs. Sally Lee, who did such a commendable job in the preparation of the illustrations; and my wife, Dorothy S. Andersen, who assisted in the final preparation of the manuscript.

Family Rotalidae

Buccella Andersen, new genus

Genotype: *Eponides hannai* Phleger and Parker.

Test free, calcareous perforate, multilocular with chambers arranged in a trochoid coil; biconvex. Dorsal side with all chambers and sutures visible; ventral side with sutures, umbilicus, and basal margin of adult chamber concealed wholly or in part with a coating of pustulose material. The primary aperture, interiomarginally situated about midway between the umbilicus and periphery on the ventral and anterior side of the last-formed chamber, is visible only from the interior of the chamber on well-preserved specimens. Single or multiple supplementary apertures, visible in some species, are developed at the postero-sutural margin of each chamber on the ventral side of the test and are typically situated in the distal portion of the chamber near the periphery.

Remarks.—The most obvious feature of the genus *Buccella* is the development of pustules on the ventral side of the test, which conceals the sutures, umbilicus, and basal, anterior margin

of the adult chamber. The diagnostic feature of *Buccella* is its supplementary apertures that are visible in a few species, but concealed in most. Weathering usually reveals the position and shape of the supplementary apertures in those species in which well-preserved specimens bear a thick coating of pustules along the ventral sutures.

Buccella can be differentiated from *Eponides* on the basis of the pustulose coating and supplementary apertures on the ventral side of the test, and from *Pseudoeponides* by the absence of elongate slits on the dorsal side of the chambers. *Eponides* has a single, simple and visible aperture at the base of the last formed chamber between the closed umbilicus and the periphery on the ventral side of the test. *Pseudoeponides* has a small, crescentic opening at the ventral border of the last chamber; loop-shaped openings along the ventral sutures radiating from the umbilicus; and elongate slits on the dorsal side at the middle part of the inner margin of each chamber.

Range.—Oligocene to Recent.

Buccella hannai (Phleger and Parker)

Figs. 3a–c

Eponides hannai Phleger and Parker, Geol. Soc. Amer. Mem. 46: 21, pl. 10, figs. 11–14. 1951.

Emended diagnosis.—Test small; trochoid; biconvex, ranging from specimens with equal convexity on dorsal and ventral sides to specimens that are extremely convex on the dorsal side and nearly flat on the ventral side. Dorsal side with surface smooth, finely perforate and hyaline (in well-preserved specimens); and with curved and limbate sutures that form the peripheral margin of each chamber. Ventral side with surface more coarsely perforate than the dorsal surface; sutures depressed and radial; chambers slightly inflated; and with umbilicus, sutures, and anterior basal margin of last-formed chamber bearing a coating of pustulose material. Periphery distinctly lobulate; typically acute and limbate although an occasional specimen (not necessarily all young specimens) has a very rounded periphery. The number of chambers in the last-formed whorl range from 7 to 9, the most common being 8. Adult tests have 3 to 3½ coils.

The only visible apertures are the supplementary apertures on the ventral side of the test. Each aperture is a low arched opening located at the posterosutural margin of each chamber. In those specimens with an acute periphery, the supplementary apertures are in a slight depression at the outer margin of the suture near the periphery. In those specimens with a rounded periphery, the apertures are located about midway between the periphery and the umbilicus.

When viewed from the interior, the adult chamber has an irregular-shaped primary aperture at the base and inner margin of the anterior wall; a septal foramen irregularly elliptical in outline and typically areal in the posterior wall that connects chambers in the same coil; and, in those forms examined, a round, septal foramen dorsally situated that connects adjacent chambers in previous coils.

Dimensions of figured specimen: Maximum diameter 0.38 mm.; maximum thickness 0.19 mm.

Remarks.—The typical form of *Buccella hannai* is easily distinguished from all other Recent species. It can be differentiated from *B. inusitata* by its smaller test and single posterosutural aperture in each chamber; from *B. frigida* by its less inflated test and visible supplementary apertures; and from *B. depressa* by its acute periphery, convex umbilicus, and visible supplementary apertures. The Oligocene form *B. vicksburgensis*, which might conceivably be the ancestor of *B. hannai*, has a less distinctly lobulate periphery and lacks the visible supplementary apertures of *B. hannai*.

Types and occurrence.—Reported from depths less than 100 meters in the northwest Gulf of Mexico (Phleger and Parker, 1951). Holotype (U.S.N.M. no. P. 835) and paratypes (U.S.N.M. nos. P. 836 and P. 838) from station 374 (lat. 28°24′ N., long. 94°42.5′ W.) at 35 meters water depth. Paratype (U.S.N.M. no. P. 837) from station 288 (lat. 26°30.5′ N., long 96°33′ W.) at 59 meters water depth.

Also recovered from a mudlump island (L.S.U. Geology Museum Sample no. M-144) off South Pass of the Mississippi River, Louisiana (H. V. Howe Collection no. 4435).

Buccella frigida (Cushman)

Figs. 4a–c, 5, 6a–c

Pulvinulina frigida Cushman, Contr. Can. Biol. 1921: 12. 1922.

Eponides frigida (Cushman), Cushman, U. S. Nat. Mus. Bull. 104, pt. 8: 45 (in part). 1931.

Eponides frigidus (Cushman), Cushman, Contr. Cushman Lab. Foram. Res. **17:** 37, pl. 9, figs. 16, 17. 1941.

Eponides frigida (Cushman), var. *calida* Cushman and Cole, Contr. Cushman Lab. Foram. Res. **6** (4): 98, pl. 13, figs. 13a–c. 1930; Cushman, U. S. Nat. Mus., Bull. 104, pt. 8: 47. 1931; Cushman, Cushman Lab. Foram. Res. Special Publ. **12**: 34, pl. 4, figs. 19, 20. 1944.

Emended diagnosis.—Test small; trochoid; biconvex. Dorsal side with smooth surface; and with narrow, slightly curved and limbate sutures oriented oblique to the peripheral margin. Ventral side with surface smooth and finely perforate; sutures slightly depressed, curved to radial, and filled with opaque pustulose material; chambers slightly inflated; and with umbilicus and basal margin of last-formed chamber bearing a thick coating of pustules. Periphery slightly lobulate, and broadly rounded. The number of chambers in the last-formed whorl range from 5 to 7, the most common being 6. Adult tests have 2½ to 3 coils.

In well-preserved specimens, all apertures are concealed by pustulose material. Weathered specimens exhibit, as shown in Fig. 5, an arched primary aperture at the basal margin of the final chamber about midway between the umbilicus and periphery, and low arched supplementary apertures located in slight depressions at the outer margin of the sutures near the periphery.

When viewed from the interior, narrow septal foramen, typically areal, connect chambers in the same coil.

Dimensions of figured specimens: lectotype (Figs. 6a–c), maximum diameter 0.46 mm., maximum thickness 0.20 mm.; hypotype (Figs. 4a–c), maximum diameter 0.46 mm., maximum thickness 0.22 mm.; and hypotype (Fig. 5), maximum diameter 0.40 mm., maximum thickness 0.20 mm.

Remarks.—The redefinition of *Buccella frigida* (Cushman) resulting from this study can be attributed to two factors: (1) That none of the original specimens identified as *Pulvinulina frigida* Cushman (1921) has been figured; and (2) that the literature has never clearly demonstrated the difference between *Eponides frigidus* (Cushman) and *E. frigida* (Cushman), Var. *calida* Cushman and Cole.

Subsequent to 1931, Cushman designated three cotypes of "*E.*" *frigidus* (Cushman Collection nos. 3031 (two specimens) and 3032 (one specimen)). On the basis of these cotypes, "*E.*" *frigida* (Cushman), var. *calida* Cushman and Cole has to be placed in synonymy with "*E.*" *frigidus*. This observation is insured in this paper by refiguring the holotype of "*E.*" *frigida*, var. *calida* (Fig. 4), and by figuring for the first time in any publication one of the cotypes (herein designated the lectotype) of "*E.*" *frigidus* (Fig. 6).

Buccella frigida (Cushman) is an extremely variable species. The typical form is relatively small and robust, with a broadly rounded periphery, six to seven chambers in each whorl, and ventral sutures that are slightly curved. This form commonly occurs in samples from Hudson Bay and along the Atlantic coast as far south as Maryland. The Pacific coast forms are generally larger and have straighter sutures, but have the same number of chambers and the thick pustulose coating in the umbilicus. Despite these differences, it appears to be inadvisable to separate the two forms at this time since both forms may occur in the same sample along with transitional forms.

B. frigida more closely resembles *B. depressa* than any other Recent or late Tertiary species. It differs from *B. depressa* by its thicker coating of pustulose material which completely fills the umbilicus and sutures, by the fewer number of chambers in each whorl, by the smaller size of the test, and by the limbate chambers on the dorsal side of the test.

Types and occurrence.—Lectotype (Cushman Collection no. 3032) from station 5, bay between Black Whale and Olasks Harbors, east coast of Hudson Bay (about lat. 55° N.) at 10 fathoms water depth. Hypotype (of "*E.*" *frigida* (Cushman), var. *calida* Cushman and Cole (Cushman Collection no. 14213)), from the Pleistocene, Talbot formation, Wailes Bluff, near Cornfield Harbor, St. Marys County, Md. Hypotype (Cushman Collection no. 64505), off Pocasset, upper end of Buzzard Bay, Mass.

Buccella depressa Andersen, n. sp.

Figs. 7a–c, 8

Eponides peruvianus Cushman and Parker (not d'Orbigny), Proc. U. S. Nat. Mus. **80** (art. 3): 19 (not figured). 1931.

Test of medium size; trochoid; dorsal and ventral sides equally biconvex. Dorsal side with surface smooth, finely perforate and hyaline (in well-preserved specimens); and with slightly curved sutures oriented oblique to the peripheral margin. Ventral side with surface more coarsely perforate than the dorsal surface; sutures greatly

depressed, nearly radial, and partly filled with opaque pustulose material; chambers inflated; and with depressed umbilicus and basal margin of last-formed chambers bearing a moderate coating of pustulose material. Periphery broadly acute to rounded and lobulate. The number of chambers in the last formed whorl ranges from 7 to 9, the most common being 8. Adult tests have $2\frac{1}{2}$ to 3 coils.

In well-preserved specimens all apertures are concealed by pustulose material. Weathered specimens exhibit, as shown in Fig. 8, a low arched primary aperture at the basal margin of the last-formed chamber and slitlike supplementary apertures that extend along the outer postero-sutural margins of each chamber.

When viewed from the interior of the test, a narrow septal foramen interomarginally situated connects chambers in the same whorl. A single round septal foramen more or less centrally located in the dorsal side of the chamber connects adjacent chambers of previous coils.

Dimensions of figured specimens: Holotype, maximum diameter 0.46 mm, maximum thickness 0.20 mm; paratype, maximum diameter 0.49 mm, maximum thickness 0.22 mm.

Remarks.—Pacific coast specimens with pustulose material on the ventral side of the test, which were not identified as "*Eponides*" *frigida* or its variety *calida*, have been indiscriminately grouped under *Eponides peruviana* (d'Orbigny) [Cushman and Kellett (1929), Cushman, Stewart, and Stewart (1930), Cushman and Valentine (1930), and Cushman and Parker (1931a)]. The Cushman and Kellett specimen has been placed in synonymy with *V. inusitata;* the Cushman, Stewart, and Stewart specimen is too badly weathered to be properly identified; the Cushman and Valentine specimen is neither *Eponides* nor *Buccella;* and the Cushman and Parker assemblage is the basis of this species *B. depressa*. The designation of the Cushman and Parker specmens as a new species is deemed advisable rather than to perpetuate an assumption that *Rotalia peruviana* d'Orbigny has a pustulose coating on the ventral side of the test.

In general appearance, *B. depressa* resembles the larger specimens of *B. frigida*. Differentiation between the two is based on the number of chambers, appearance of sutures, and intersity of the pustulose coating. *B. depressa* has more chambers in each whorl, much more depressed sutures and umbilicus, less pustulose material deposited in the sutures and umbilicus, and less limbate sutures on dorsal side than *B. frigida*. Other Recent species, *B. hannai*, and *B. inusitata*, can be distinguished from *B. depressa* by their acute peripheries.

Types and occurrence.—Holotype (U.S.N.M. no. P. 833) and paratype (U.S.N.M. no. P. 834) from station 97, Port Williams, Falklands, at 8 to 10 fathoms. Unfigured paratypes (Cushman Collection no. 21256) from same locality as above and unfigured paratypes (Cushman Collection no. 21257) from station 87, off lower jetty, Port Howard, Falklands, at 4 fathoms.

FIG. 1, 2.—*Buccella vicksburgensis* (Cushman and Ellisor): 1a, Dorsal view of holotype (Cushman Coll. no. 15521); 1b, ventral view; and 1c, edge view (note: opening is fracture not aperture); 2a, dorsal view of hypotype (holotype of *Eponides alabamensis* Cushman and McGlamery, Cushman Coll. no. 23678); 2b, ventral view; 2c, edge view. Oligocene and L. Miocene?.

FIG. 3.—*Buccella hannai* (Phleger and Parker): 3a, Dorsal view of holotype (U.S.N.M. no. P 835); 3b, ventral view showing supplementary apertures at outer margin of suture; 3c, edge view. Recent, Gulf of Mexico.

FIGS. 4–6.—*Buccella frigida* (Cushman): 4a, Dorsal view of hypotype (holotype of *Eponides frigida* (Cushman), var. *calida* Cushman and Cole, Cushman Coll. no. 14213); 4b, ventral view; and 4c, edge view; 5, ventral view of weathered hypotype (Cushman Coll. no. 64505) showing position of supplementary apertures normally concealed by pustules; 6a, dorsal view of lectotype (Cushman Coll. no. 3032); 6b, ventral view; 6c, edge view. Late Tertiary to Recent.

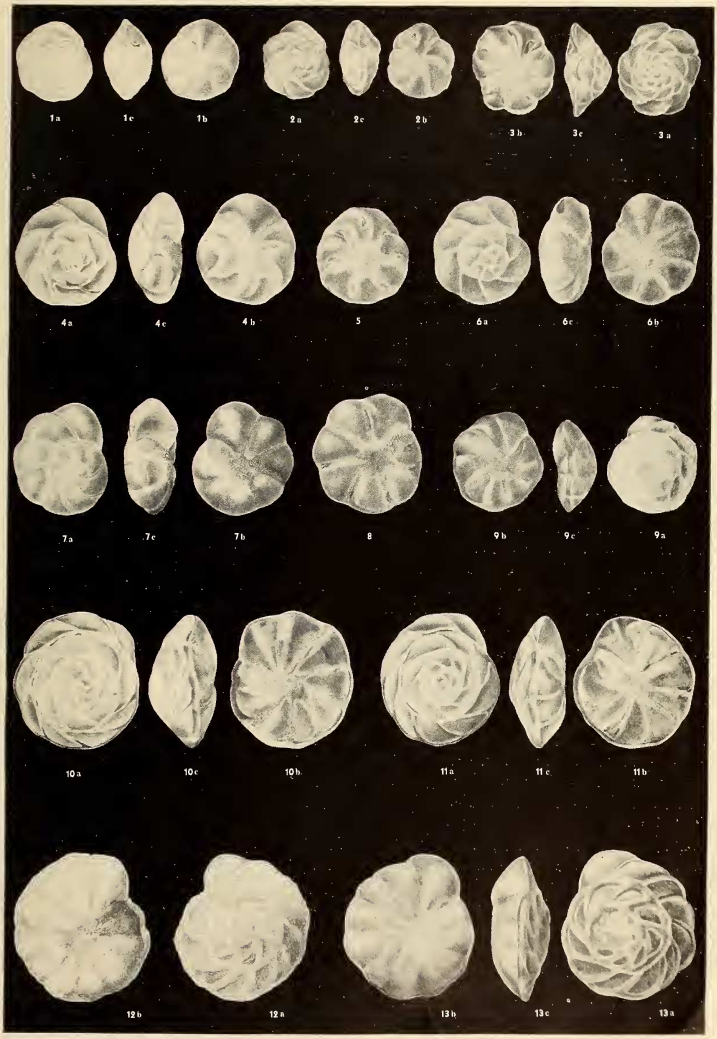
FIGS. 7, 8.—*Buccella depressa* Andersen, n. sp.: 7a, Dorsal view of holotype (U.S.N.M. no. P 833); 7b, ventral view; 7c, edge view; 8, ventral view of weathered paratype (U.S.N.M. no. P 834) showing position of supplementary apertures normally concealed by pustules. Recent.

FIG. 9.—*Buccella parkerae* Andersen, n. sp.: 9a, Dorsal view of holotype (Cushman Coll. no. 14582); 9b, ventral view; 9c, edge view. Miocene.

FIGS. 10, 11.—*Buccella inusitata* Andersen, n. sp.: 10a, Dorsal view of holotype (Cushman Coll. no. 64503); 10b, ventral view; 10c, edge view; 11a, dorsal view of paratype (Cushman Coll. no. 64504); 11b, ventral view; 11c, edge view. Recent.

FIGS. 12, 13.—*Buccella mansfieldi* (Cushman): 12a, Dorsal view of hypotype (Cushman Coll. no. 46507); 12b, ventral view; 12c, edge view; 13a, dorsal view of hypotype (Cushman Coll. no. 46506); 13b, ventral view; 13c, edge view. Miocene.

All magnifications ×50.



Figs. 1–13.—(See opposite page for legend).

Buccella inusitata Andersen, n. sp.

Figs. 10a–c and 11a–c

Eponides frigidus (Cushman), Cushman and Todd, Cushman Lab. Foram. Res. Special Publ. **21:** 21 (Cushman Collection no. 48597 not figured). 1947.

Eponides peruvianus Cushman and Kellett (not d'Orbigny), Proc. U. S. Nat. Mus. **75** (art. 25): 10, pl. 4, figs. 5a–c. 1929.

Eponides frigidus (Cushman), Cushman, Cushman Lab. Foram. Res. Special Publ. **23:** 71, pl. 8, fig. 7. 1938.

Test of medium size; trochoid; dorsal and ventral sides equally biconvex in the microspheric form; megalospheric generation with the ventral side nearly flat and dorsal side extremely convex. Dorsal side with surface smooth, finely perforate and hyaline; and with slightly limbate sutures oriented strongly oblique to the peripheral margin and confluent with the periphery. Ventral side with surface rough and more coarsely perforate than the dorsal side; sutures depressed and radial; chambers slightly inflated, and with umbilicus, sutures, and basal margin of the last-formed chamber bearing a thick coating of pustulose material. Periphery acute and limbate, and with the last 2 or 3 chambers usually lobate. The number of chambers in the last-formed whorl ranges from 7 to 9, the most common being 9. Adult tests have 3 to 3½ coils.

The only visible apertures are located on the ventral side of the test at the outer margin of each suture. In a slight depression near the periphery is a concentration of pustulose material through which are numerous, irregularly shaped openings. These openings eminate from the posterosutural margin of the younger (most recently added) chamber and from the antero-sutural margin of the older (preceding) chamber.

The last-formed chamber when viewed from the interior has no well defined anterior aperture. Preceding chambers, however, have a well developed, narrow septal foramen interomarginally situated and numerous areal cribrate openings near the periphery which connect chambers in the same coil. One or two lateral foramen connect adjacent chambers of previous coils.

Dimensions of figured specimens: Holotype, maximum diameter 0.57 mm, maximum thickness 0.27 mm; paratype, maximum diameter 0.55 mm, maximum thickness 0.24 mm.

Remarks.—Buccella inusitata is characterized by its large test, by its acute and limbate periphery, by its limbate dorsal sutures, and by its supplementary apertures consisting of numerous irregularly shaped openings. It can be distinguished from *B. frigida* and *B. depressa* by its greater size and acute periphery; from *B. hannai* by its greater size and multiple openings in the outer portion of the ventral sutures; and from *B. mansfieldi* by its smaller size, lack of raised and limbate dorsal sutures, and greater development of pustulose material along the sutures. *B. inusitata* most closely resembles *B. oregonensis* from which it differs in having more inflated chambers on the ventral side of the test; less convexity in the umbilicus; and multiple supplementary apertures.

Types and occurrence.—Holotype (Cushman Collection no. 64503) and paratype (Cushman Collection no. 64504) from Dallas Bank, Straits of Juan de Fuca, station "A," coast of Washington. Unfigured paratypes (Cushman Collection no. 48597) from same locality as holotype. Station "A" refers to the list of stations in Special Publication 21 (Cushman and Todd, 1947).

Buccella mansfieldi (Cushman)

Figs. 12a, b and 13a–c

Eponides mansfieldi Cushman, Florida Geol. Surv. Bull. 4: 54, pl. 11, figs. 1a–c. 1930.

Emended diagnosis.—Test large for the genus; trochoid; biconvex, ranging from specimens with equal convexity on dorsal and ventral sides to specimens less convex on the ventral side. Dorsal side with surface finely perforate and hyaline (in well-preserved specimens); and with broadly limbate and raised sutures oriented oblique to the peripheral margin and confluent with the periphery. Ventral side with surface rough and more coarsely perforate than the dorsal side; sutures depressed and radial; chambers slightly inflated; and with the depressed umbilicus, sutures, and anterior, basal margin of the last-formed chamber bearing a coating of pustulose material (a few specimens have pustules covering the entire ventral side of the test). Periphery acute, broadly limbate, and lobulate. The number of chambers in the last whorl range from 9 to 12, the most common being 11. Adult test with 2½ to 3 coils.

All apertures are concealed by pustulose material. When viewed from the interior, the adult chamber has an irregularly shaped opening at the

base and inner margin of the anterior wall, and a long, narrow slitlike opening at the base and outer margin of the posterior wall. This slitlike opening which, externally, would lie at the posteriosutural margin of the chamber, is so minute that it can not be discerned even in weathered specimens.

Comma-shaped, internal septal foramen connect adjacent chambers in the same coil; none appear to connect chamber in previous coils.

Dimensions of figured specimens: Hypotype (Fig. 12), maximum diameter 0.62 mm, maximum thickness 0.28 mm; hypotype (Fig. 13), maximum diameter 0.62 mm, maximum thickness 0.25 mm.

Remarks.—*Buccella mansfieldi* is larger, has a greater number of chambers, and has a more ornamented dorsal surface than any other species. It lacks the open supplementary apertures of *B. hannai* and *B. inusitata*. Even weathered specimens fail to exhibit supplementary apertures in the striking manner of some specimens of *B. frigida*, *B. depressa*, and *B. vicksburgensis*. The most evident characteristic of the genus *Buccella* exhibited by *B. mansfieldi* is the pustulose material coating the ventral side of the test.

Types and occurrence.—Hypotype, Fig. 12 (Cushman Collection no. 46507), is from the Choctawhatchee marl of John Anderson's farm, ¾ mile east of Red Bay, Walton County, Fla. It is from the same locality as the holotype (U.S.N.M. no. 371079), although it was not designated a paratype by Cushman. Hypotype, Fig. 13 (Cushman Collection no. 64506), is from the Miocene Choctawhatchee formation, Yoldia zone, Old Frazier farm, ¼ mile south of center of section 18, T. 2 N., R 19 W., Walton County, Fla.

Buccella oregonensis (Cushman, R. E. Stewart, and K. C. Stewart)

Eponides mansfieldi Cushman, var. *oregonensis* Cushman, Stewart, and Stewart, Oregon Dept. Geol. and Min., Ind. Bull. 36, (2): 43, pl. 6, fig. 4. 1947(1948).

Remarks.—The holotype of *B. oregonensis* (Cushman, Stewart, and Stewart) is the only representative of the species in the Cushman Collection. This constitutes an inadequate number of specimens upon which to base a study, and in this species it is particularly inadvisable since the final chamber of the holotype is broken. There is sufficient evidence, however, that the species belongs with the genus *Buccella*, and that there is no justification in continuing to consider it a variety of *B. mansfieldi*. *B. oregonensis* has neither the size nor dorsal ornamentation of *B. mansfieldi*. The species most similar to *B. oregonensis* is *B. inusitata*. Differentiation between the two is based on the more inflated chambers on the ventral side of the test, the less convex umbilicus and the multiple supplementary apertures of *B. inusitata*.

Types and occurrence.—Holotype (Cushman Collection no. 44208) from the Miocene shale of the Astoria formation, 700 feet southeast of Yaquina Head, Yaquina quadrangle, Oreg.

Buccella parkerae Andersen, n. sp.
Figs. 9a–c

Eponides mansfieldi Cushman, Cushman and Parker (not Cushman, 1930), Contr. Cushman Lab. Foram. Res. **7** (1): pl. 2, fig. 10a–c. 1931.

Test small; trochoid; biconvex, dorsal side nearly conoidal, ventral side with an umbilical flattening. Dorsal side with surface coarsely perforate; and with sutures of variable intensity; in the early coils concealed by a thin exogenous covering of shell material, in the last coil distinct, limbate, and in some specimens slightly raised above the surface of the test. Ventral side with surface coarsely perforate; depressed sutures radial near the umbilicus and abruptly curved backward at the peripheral margin; umbilicus depressed; and with umbilicus, sutures, and basal margin of the last-formed chamber bearing a coating of pustulose material, thickly deposited in the umbilicus, less densely deposited in the outer portion of the sutures. Periphery acute, limbate and slightly lobulate. The number of chambers in the last-formed whorl range from 9 to 11, 11 being the most common. Adult tests with 2½ to 3 coils.

The primary aperture is concealed by pustules. Supplementary apertures on the ventral side of the test are located in the slight depression at the outer margin of the suture near the periphery. Each aperture is a long, slitlike opening barely visible under high magnification.

When viewed from the interior, comma-shaped septal foramen connect chambers in the same coil.

Dimensions of figured holotype: maximum diameter 0.42 mm; maximum thickness 0.17 mm.

Remarks.—*Buccella parkerae*, originally identified as *Eponides mansfieldi* by Cushman and

Parker (1931b), has a superficial resemblance to the Florida species. It differs from *B. mansfieldi*, however, in its smaller size and less intensely ornamented dorsal surface. In *B. mansfieldi* the raised sutures on the dorsal side of the test are clearly defined from the proloculus to the periphery. In *B. parkerae* the proloculus and early coils of the dorsal spire are concealed by a thin coating of exogenous material that produces a low, conoidal capping in the center of the test. Only the last-formed coil or coil and half has distinct sutures with the barest indication being raised above the surface of the test.

Buccella parkerae can be distinguished from all other Pacific coast forms by the exogenous material on the dorsal side of the test. In addition, *B. parkerae* differs from *B. inusitata* by its raised dorsal sutures, smaller size, and more curved ventral sutures; from *B. depressa* by its acute periphery, limbate and raised dorsal sutures, and less depressed umbilicus; and from *B. oregonensis* by its smaller size, and depressed umbilicus.

Types and occurrence.—Holotype (Cushman Collection no. 14582), and unfigured paratypes (Cushman Collection no. 14583), from the Miocene, upper Tremblor formation, 1,500 feet west and 1,000 feet south of northeast corner of section 3, T. 28 S., R. 28 E., M.D.B.M., east side of San Joaquin Valley, Calif.

Buccella vicksburgensis (Cushman and Ellisor)

Figs. 1a–c, 2a–c

Eponides vicksburgensis Cushman and Ellisor, Contr. Cushman Lab. Foram. Res. **7** (3): 56, pl. 7, figs. 8a–c. 1931.

Eponides alabamensis Cushman and McGlamery, U. S. Geol. Surv. Prof. Paper 189-D: 110, pl. 27, fig. 2. 1938.

Eponides choctawensis Cushman and McGlamery, U. S. Geol. Surv. Prof. Paper 189-D: 110, pl. 27, fig. 1. 1938.

Emended diagnosis.—Test small, trochoid; biconvex, megalospheric forms with dorsal side strongly convex, microspheric forms with ventral side slightly flattened. Dorsal side with surface smooth, finely perforate and hyaline (in well-preserved specimens); and with limbate sutures oriented oblique to the peripheral margin and confluent with the limbate periphery. Ventral side with surface rough and more coarsely perforate than the dorsal side; sutures slightly depressed and slightly curved; and with chambers slightly inflated. Typical specimens have pustulose only on the sutures, umbilicus, and anterior basal margin of the last-formed chamber. Megalospheric forms have a slightly rounded periphery; microspheric forms have an acute, limbate and slightly lobulate periphery. The number of chambers in the last whorl range from 6 to 8, the most common being 7. Adult tests with $2\frac{1}{2}$ coils.

All apertures are concealed by pustulose material. An occasional weathered specimen reveals the posterosutural apertures in slight depressions near the peripheral margin on the ventral side of the test. When viewed from the interior, the final chamber has an irregularly shaped opening at the base and inner margin of the anterior wall and a small arched opening at the base and outer margin of the posterior wall.

Also from the interior, comma-shaped septal foramen connect adjacent chambers in the same coil; and rounded septal foramen, laterally situated in each chamber connect adjacent chambers in previous coils.

Dimensions of figured specimens: Holotype, maximum diameter 0.33 mm, maximum thickness 0.20 mm. Hypotype (holotype for "*E. alabamensis*") maximum diameter 0.32 mm, maximum thickness 0.17 mm.

Remarks.—The factors which have a bearing on the placement of "*Eponides alabamensis*" and "*E. choctawensis*" in synonymy with *B. vicksburgensis* are: (1) Morphologic homogeneity noted in the actual specimens not discernible from the original descriptions and illustrations; and (2) the number of specimens of a species reported in the literature.

"*E.*" *vicksburgensis* and "*E. alabamensis*" were found to be incorrectly described and illustrated. In "*E.*" *vicksburgensis*, the opening at the base is a void produced by breakage not an aperture prepared by the animal; and the sutures on the ventral side of the test are more concealed by pustules than illustrated. In "*E. alabamensis*" the aperture is concealed by pustules, not open as illustrated and described; there are no costae across the sutures on the ventral side of the test as illustrated and described in the text; and the sutures on the ventral side of the test are more nearly concealed with pustules than illustrated. When purged of inaccuracies, the descriptions reflect the morphologic similarity apparent in the actual specimens. Additive proof of this morphologic similarity lies in an assemblage of specimens identified as *Eponides alabamensis* (Cushman Collection no. 25950) from the Chickasawhay marl near Millry, Ala. This assemblage

contains specimens with the thick coating of pustules on the ventral side of the test similar to the holotype of "*E.*" *vicksburgensis*, and also specimens with the reduced pustulose coating on the ventral side of the test that characterizes the holotype of "*E. alabamensis.*"

"*Eponides choctawensis*" has been reported three different times: Cushman and McGlamery, 1938; Cushman and McGlamery, 1942; and Cushman and Todd, 1946. In the last two reports the presence of the species in the sample is based on a single specimen. It is even possible that the holotype is based on a single specimen since there are no paratypes in the Cushman Collection. In addition to the limited number of specimens available of "*E. choctawensis,*" it is also significant to note that "*E. choctawensis*" has been reported only from samples in which "*E. alabamensis*" (*B. vicksburgensis*) is also present and well represented by a number of specimens. The conclusion drawn is that "*E. choctawensis*" probably represents a varient or phase in the life cycle of *B. vicksburgensis* and therefore does not warrant a separate specific name. An analogy can be drawn with *B. hannai* in which a small, rare form with more inflated chambers and a more lobulate and rounded periphery than the typical form is accepted in the species (Phleger and Parker, 1951).

The typical specimen of *B. vicksburgensis* is easily distinguished from any other species of *Buccella* by its thick pustulose coating on the ventral side of the test. In comparison with other Atlantic and Gulf Coast forms and in addition to the above characteristic, it can be differentiated from B. mansfieldi by its smaller size, and lack of ornamentation of the dorsal sutures; from *B. frigida* by its acute periphery; and from *B. hannai* by its lack of open supplementary apertures, and less lobate periphery.

REFERENCES

Asano, Kiyoshi. *Illustrated catalogue of Japanese Tertiary smaller Foraminifera, Part 14: Rotaliidae.* Institute of Geology and Paleontology, Tohoku University, Japan, 1951.

Brotzen, Fritz. *Foraminiferengattung* Gravelinella *Nov. Gen. und die Systematik Rotaliiformes,* Sver. Geol. Unders., Sec. C, no. 451. 1942.

Cushman, J. A. *Results of the Hudson Bay Expedition 1920. I, The Foraminifera.* Contr. Can. Biol. *1920.* 1922.

———. *The Foraminifera of the Choctawhatchee Formation of Florida.* Florida State Geol. Surv. Bull. 4. 1930.

———. *The Foraminifera of the Atlantic Ocean. Part 8. Rotaliidae, Amphisteginidae, Calcarinidae, Cymbaloporettidae, Globorotaliidae, Anomalinidae, Planorbulinidae, Rupertiidae, and Homotremidae.* U. S. Nat. Mus. Bull. 104, pt. 8. 1931.

———. *Some fossil Foraminifera from Alaska.* Contr. Cushman Lab. Foram. Res. **17**, pt. 2. 1941.

———. *Foraminifera from the shallow water of the New England coast.* Cushman Lab. Foram. Res. Special Publ. **12**. 1944.

———. *Arctic Foraminifera.* Cushman Lab. Foram. Res. Special Publ. **23**. 1948.

Cushman, J. A., and Cole, W. S. *Pleistocene Foraminifera from Maryland.* Contr. Cushman Lab. Foram. Res. **6**, pt. 4. 1930.

Cushman, J. A., and Ellisor, A. C. *Some new Tertiary Foraminifera from Texas.* Contr. Cushman Lab. Foram. Res. **7**, pt. 3. 1931.

Cushman, J. A., and Kellett, B. *Recent Foraminifera from the west coast of South America.* Proc. U. S. Nat. Mus. **75**, art. 25. 1929.

Cushman, J. A., and McGlamery, W. *Oligocene Foraminifera near Millry, Alabama.* U. S. Geol. Surv. Prof. Paper 197-B. 1942.

Cushman, J. A., and Parker, F. L. *Recent Foraminifera from the Atlantic coast of South America.* Proc. U. S. Nat. Mus. **80**, art. 3. 1931a.

———. *Miocene Foraminifera from the Temblor of the east side of the San Joaquin Valley, California.* Contr. Cushman Lab. Foram. Res. **7**, pt. 1. 1931b.

Cushman, J. A., Stewart, R. E., and Stewart, K. C. *Tertiary Foraminifera from Humboldt County, California. A preliminary survey of the fauna.* Trans. San Diego Soc. Nat. Hist. **6**, pt. 2. 1930.

———. *Astoria Miocene Foraminifera from Agate Beach, Lincoln County, Oregon.* Oregon Dept. Geol. and Min. Ind. Bull. **36**, pt. 2. 1947.

Cushman, J. A., and Todd, R. *A foraminiferal fauna from the Byram Marl at its type locality.* Contr. Cushman Lab. Foram. Res. **22**, pt. 3. 1946.

———. *Foraminifera from the coast of Washington.* Cushman Lab. Foram. Res. Special Publ. **21**. 1947.

Cushman, J. A., and Valentine, W. W. *Shallow-water Foraminifera from the Channel Islands of southern California.* Contr. Dept. Geol. Stanford Univ. **1**, no. 1. 1930.

Hofker, J. *What is the genus* Eponides? Micropaleontologist **4** (1). 1950.

———. *The Foraminifera of the Siboga Expedition, Part III.* Monographie IVa de: Uitkomsten op Zoologisch, Botanisch, Oceanographish en Geologisch Gegied. Leiden, 1951.

d'Orbigny, A. D. *Voyage dans l'Amérique Méridionale* **5**, pt. 2. 1839.

Phleger, F. B., and Parker, F. L. *Ecology of Foraminifera, northwest Gulf of Mexico,* Geol. Soc. Amer. Mem. **46**. 1951.